Complete Summary

GUIDELINE TITLE

Emergency and inpatient management of asthma.

BIBLIOGRAPHIC SOURCE(S)

Institute for Clinical Systems Improvement (ICSI). Emergency and inpatient management of asthma. Bloomington (MN): Institute for Clinical Systems Improvement (ICSI); 2004 Dec. 38 p. [53 references]

GUIDELINE STATUS

This is the current release of the guideline.

COMPLETE SUMMARY CONTENT

SCOPE

DISEASE/CONDITION(S)

Asthma exacerbation

GUIDELINE CATEGORY

Evaluation
Management
Risk Assessment
Treatment

CLINICAL SPECIALTY

Allergy and Immunology
Emergency Medicine
Family Practice

Internal Medicine
Nursing
Pediatrics
Pharmacology
Pulmonary Medicine

INTENDED USERS

Advanced Practice Nurses
Allied Health Personnel
Emergency Medical Technicians/Paramedics
Health Care Providers
Health Plans
Hospitals
Managed Care Organizations
Nurses
Pharmacists
Physician Assistants
Physicians
Respiratory Care Practitioners

GUIDELINE OBJECTIVE(S)

- To improve the timely and accurate assessment of patients presenting with asthma exacerbation
- To improve the treatment and management of inpatient asthma

TARGET POPULATION

- Patients age 5 years and older with asthma presenting to the Emergency Room
- Patients 5 years and older with asthma in inpatient hospital setting

INTERVENTIONS AND PRACTICES CONSIDERED

Evaluation/Risk Assessment

1. Prompt assessment of asthma severity including history, physical examination, lung function tests (forced expiratory volume in one second [FEV_1] or peak expiratory flow [PEF], oxygen saturation and other tests as indicated), and laboratory studies, such as arterial blood gases (ABGs), chest X-ray (CXR), complete blood count (CBC), electrocardiogram (ECG), electrolytes, and theophylline level.
2. Assessment of risk factors for death from asthma

Treatment/Management

1. Initial treatment with albuterol or albuterol HFA or albuterol solution.
2. Oral or intravenous corticosteroids, anticholinergics (ipratropium bromide) as an additional bronchodilator in conjunction with a $beta_2$-agonist, levalbuterol, BiPAP® therapy, heliox, ketamine and magnesium sulfate in severe cases

Note: The guideline developers considered, but did not find sufficient evidence to recommend the following drugs: inhaled corticosteroids, montelukast

3. Discharge home with necessary medications and instructions how to use them, an action plan for managing recurrence of airflow obstructions, and a follow-up appointment
4. Hospital admission as indicated
5. Patient reassessment (repeat step 1)
6. Continue treatment (repeat steps 3 and 4), consider other illnesses and comorbidities
7. Admit to Intensive Care Unit if condition deteriorates

MAJOR OUTCOMES CONSIDERED

Effect of combination treatment (beta$_2$-agonist with ipratropium bromide) on asthma score, oxygen saturation, rate of hospitalization, and incidence of side effects

METHODOLOGY

METHODS USED TO COLLECT/SELECT EVIDENCE

Searches of Electronic Databases

DESCRIPTION OF METHODS USED TO COLLECT/SELECT THE EVIDENCE

Not stated

NUMBER OF SOURCE DOCUMENTS

Not stated

METHODS USED TO ASSESS THE QUALITY AND STRENGTH OF THE EVIDENCE

Weighting According to a Rating Scheme (Scheme Given)

RATING SCHEME FOR THE STRENGTH OF THE EVIDENCE

Key conclusions (as determined by the work group) are supported by a conclusion grading worksheet that summarizes the important studies pertaining to the conclusion. Individual studies are classed according to the system presented below, and are designated as positive, negative, or neutral to reflect the study quality.

Conclusion Grades:

Grade I: The evidence consists of results from studies of strong design for answering the question addressed. The results are both clinically important and

consistent with minor exceptions at most. The results are free of any significant doubts about generalizability, bias, and flaws in research design. Studies with negative results have sufficiently large samples to have adequate statistical power.

Grade II: The evidence consists of results from studies of strong design for answering the question addressed, but there is some uncertainty attached to the conclusion because of inconsistencies among the results from the studies or because of minor doubts about generalizability, bias, research design flaws, or adequacy of sample size. Alternatively, the evidence consists solely of results from weaker designs for the question addressed, but the results have been confirmed in separate studies and are consistent with minor exceptions at most.

Grade III: The evidence consists of results from studies of strong design for answering the question addressed, but there is substantial uncertainty attached to the conclusion because of inconsistencies among the results of different studies or because of serious doubts about generalizability, bias, design flaws, or adequacy of sample size. Alternatively, the evidence consists solely of results from a limited number of studies of weak design for answering the question addressed.

Grade Not Assignable: There is no evidence available that directly supports or refutes the conclusion.

Study Quality Designations:

The quality of the primary research reports and systematic reviews are designated in the following ways on the conclusion grading worksheets:

Positive: indicates that the report or review has clearly addressed issues of inclusion/exclusion, bias, generalizability, and data collection and analysis.

Negative: indicates that these issues (inclusion/exclusion, bias, generalizability, and data collection and analysis) have not been adequately addressed.

Neutral: indicates that the report or review is neither exceptionally strong nor exceptionally weak.

Not Applicable: indicates that the report is not a primary reference or a systematic review and therefore the quality has not been assessed.

Classes of Research Reports:

A. Primary Reports of New Data Collection:

Class A:

- Randomized, controlled trial

Class B:

- Cohort study

Class C:

- Nonrandomized trial with concurrent or historical controls
- Case-control study
- Study of sensitivity and specificity of a diagnostic test
- Population-based descriptive study

Class D:

- Cross-sectional study
- Case series
- Case report

B. Reports that Synthesize or Reflect upon Collections of Primary Reports:

Class M:

- Meta-analysis
- Systematic review
- Decision analysis
- Cost-effectiveness analysis

Class R:

- Consensus statement
- Consensus report
- Narrative review

Class X:

- Medical opinion

METHODS USED TO ANALYZE THE EVIDENCE

Review of Published Meta-Analyses
Systematic Review with Evidence Tables

DESCRIPTION OF THE METHODS USED TO ANALYZE THE EVIDENCE

Not stated

METHODS USED TO FORMULATE THE RECOMMENDATIONS

Not stated

RATING SCHEME FOR THE STRENGTH OF THE RECOMMENDATIONS

Not applicable

COST ANALYSIS

A formal cost analysis was not performed and published cost analyses were not reviewed.

METHOD OF GUIDELINE VALIDATION

Clinical Validation-Pilot Testing
Internal Peer Review

DESCRIPTION OF METHOD OF GUIDELINE VALIDATION

Institute Partners: System-Wide Review

The guideline draft, discussion and measurement specification documents undergo thorough review. Written comments are solicited from clinical, measurement, and management experts from within the member medical groups during an eight-week period of "Critical Review".

Each of the Institute's participating medical groups determines its own process for distributing the guideline and obtaining feedback. Clinicians are asked to suggest modifications based on their understanding of the clinical literature coupled with their clinical expertise. Representatives from all departments involved in implementation and measurement review the guideline to determine its operational impact. Measurement specifications for selected measures are developed by the Institute for Clinical Systems Improvement (ICSI) in collaboration with participating medical groups following general implementation of the guideline. The specifications suggest approaches to operationalizing the measure.

Guideline Work Group: Second Draft

Following the completion of the "Critical Review" period, the guideline work group meets 1-2 times to review the input received. The original guideline is revised as necessary and a written response is prepared to address each of the suggestions received from medical groups. Two members of the Respiratory Steering Committee carefully review the Critical Review input, the work group responses, and the revised draft of the guideline. They report to the entire committee their assessment of two questions: (1) Have the concerns of the medical groups been adequately addressed? (2) Are the medical groups willing and able to implement the guideline? The committee then either approves the guideline for pilot testing as submitted or negotiates changes with the work group representative present at the meeting.

Pilot Test

Medical groups introduce the guideline at pilot sites, providing training to the clinical staff and incorporating it into the organization's scheduling, computer and other practice systems. Evaluation and assessment occurs throughout the pilot test phase, which usually lasts for three months. Comments and suggestions are solicited in the same manner as used during the "Critical Review" phase.

The guideline work group meets to review the pilot sites' experiences and makes the necessary revisions to the guideline, and the Respiratory Steering Committee reviews the revised guideline and approves it for implementation.

RECOMMENDATIONS

MAJOR RECOMMENDATIONS

The recommendations for emergency and inpatient management of asthma are presented in the form of two algorithms with 26 components, accompanied by detailed annotations. Algorithms are provided for Emergency Room Management of Asthma and Hospital Management of Asthma; clinical highlights and selected annotations (numbered to correspond with the algorithm) follow.

Class of evidence (A-D, M, R, X) and conclusion grade (I-III, Not Assignable) definitions are repeated at the end of the "Major Recommendations" field.

Clinical Highlights and Recommendations

1. Assess severity using objective measures; treatment corresponds to each level.(Annotation #2)
2. Provide the opportunity for asthma education in the Emergency Room (ER) and/or inpatient settings.(Annotation #10)
3. Corticosteroids should be used in the treatment of acute asthma.(Annotation #11)
4. Early intervention with BiPAP ® may prevent mechanical intubations.(Annotation #12)
5. Patients receive appropriate follow-up as per Diagnosis and Management of Asthma guideline. (Annotation #10)

Emergency Room Management Algorithm Annotations

2. Assess Severity of Asthma Exacerbation

   Key Point:

   - Severity should be promptly assessed using objective measures of lung function.

   Patients presenting with an acute exacerbation of their asthma should receive prompt evaluation to assess the severity of their symptoms. Treatment should begin as rapidly as possible even while still assessing severity.

   Assessment of asthma severity should include history, physical examination, an objective measure of lung function, either forced expiratory volume in one second (FEV_1) or peak expiratory flow (PEF), oxygen saturation and other tests as indicated.

   History

- Breathlessness (shortness of breath, dyspnea)
- Severity of symptoms, limitations, and sleep disturbance
- Duration of symptoms
- Current medical treatment plan
- Adherence to medical treatment plan
- Rescue medication use:
    - recent use of short acting beta$_2$-agonists
    - number of bursts of oral steroids in past year
- Review Asthma Action Plan and daily charting of peak flows
- Previous ER visits or hospitalization
- Record triggers:
    - Upper respiratory infection (URI)
    - Bronchitis, pneumonia, sinusitis
    - Exposure to allergens or irritants
    - Exercise
    - Gastrointestinal reflux disease (GERD)

Clinicians treating asthma exacerbations should be familiar with the characteristics of patients at risk for life-threatening deterioration.

Risk Factors for Death from Asthma

- Past history of sudden severe exacerbations
- Prior intubation for asthma
- Prior admission for asthma to an intensive care unit
- Three or more emergency care visits for asthma in the past year
- Hospitalization or an emergency care visit for asthma within the past month
- Use of more than 2 canisters per month of inhaled short-acting beta$_2$-agonist
- Current use of systemic corticosteroids or recent withdrawal from systemic corticosteroids
- Difficulty perceiving airflow obstruction or its severity
- Serious psychiatric disease or psychosocial problems
- Low socioeconomic status and urban residence
- Illicit drug use

Source: NAEPP Expert Panel Report: Update 2002

Note: The Food and Drug Administration has reported that salmeterol may be associated with and increased risk of death from asthma.

Lung Function

- Spirometry (FEV_1) - preferred or
- Peak flow (PEF)
- Pulse oximetry

Physical Exam

- Vital signs: Temperature, blood pressure, pulse rate, respiratory rate, pulsus paradoxus
- Alertness
- Ability to talk
- Use of accessory muscles
- Auscultation of chest
- Color

Laboratory Studies

- Arterial Blood Gases (ABGs)
- Chest X-Ray (CXR)
- Complete Blood Count (CBC)
- Electrocardiogram (EKG)
- Electrolytes
- Theophylline level

Assessment of severity should be based on the following table:

Classifying Severity of Asthma Exacerbation				
	Mild	Moderate	Severe	Respiratory Arrest Imminent
Symptoms				
Breathlessness	While walking Can lie down	While talking Prefers sitting	While at rest Sits upright	
Talks in	Sentences	Phrases	Words	
Alertness	May be agitated	Usually agitated	Usually agitated	Drowsy or confused
Signs				
Respiratory rate	Increased	Increased	Often > 30/min	
Use of accessory muscles; suprasternal retractions	Usually not	Commonly	Usually	Paradoxical thoracoabdominal movement
Wheeze	Moderate, often only end expiratory	Loud; throughout exhalation	Usually loud; throughout inhalation and exhalation	Absence of wheeze
Pulse/minute	<100	100-120	>120	Bradycardia
Pulsus paradoxus	Absent <10 mm Hg	May be present 10-25 mm Hg	Often present >25 mm Hg (adult); 20-40 mm Hg (child)	Absence suggests respiratory muscle fatigue
Functional Assessment				
FEV_1 or PEF % predicted or % personal best	>80%	Approx. 50-80% or response	< 50% predicted or personal best	

Classifying Severity of Asthma Exacerbation				
	Mild	Moderate	Severe	Respiratory Arrest Imminent
Symptoms				
		lasts < 2 hours		
PaO_2 (on air)	Normal (test not usually necessary)	>60 mm Hg (test not usually necessary)	<60 mm Hg: possible cyanosis	
And/or PCO_2	<42 mm Hg (test not usually necessary)	<42 mm Hg (test not usually necessary)	≥42 mm Hg: possible respiratory failure (see text)	
SaO_2 % (on air) at sea level	> 95% (test not usually necessary)	91-95%	<91%	
	Hypercapnia (hypoventilation) develops more readily in young children than in adults and adolescents			

Note:

- The presence of several parameters, but not necessarily all, indicates the general classification of the exacerbation.
- Many of these parameters have not been systematically studied, so they serve only as general guides.

Adapted from NAEPP Expert Panel Report

For alternate scoring system, please see Additional Studies section in the original guideline document.

5. Initial Treatment

Note: If patient has had prior treatment with a beta-agonist before reaching the Emergency Room (ER), see Annotation #11.

Usual treatment is with short-acting $beta_2$-agonist by metered dose inhaler or nebulizer:

- Albuterol or Albuterol HFA (90 micrograms per puff) 4-8 puffs
- Albuterol Solution 2.5 to 5 mg by nebulizer

10. Discharge Home

Key Point:

- At discharge, provide patients with necessary medications and education in how to use them, instruction in self-assessment, an action plan for managing recurrence of airflow obstruction, and a follow-up appointment.

A. Medications

1. Inhaled $beta_2$-agonist every 2-6 hours.
2. Systemic corticosteroids are almost always the treatment of choice in patients with acute asthma exacerbation. Corticosteroids aid symptom resolution and prevent asthma relapse.
3. Initiate or increase anti-inflammatory medication:
    - Inhaled corticosteroids

      The role of inhaled corticosteroids after an emergency room visit is controversial. However, it is the consensus of this group that inhaled corticosteroids should be encouraged at the time of discharge.

    - Consider leukotriene modifiers as an additive therapy.

4. Antibiotics are not routinely used but may be warranted if patient has signs of acute bacterial infection, fever and purulent sputum.
5. Long-acting $beta_2$-agonists as monotherapy are NOT recommended.

See Appendix A in the original guideline document for medication dosages.

Evidence supporting this recommendation is of classes: A, M

B. Asthma Action Plan

The plan should describe the signs, symptoms, and/or peak flow values that should prompt increases in self-medication, contact with a health care provider, or return for emergency care. The plan given at discharge from the emergency department may be quite simple (e.g., instructions for discharge medications and returning for care should asthma worsen). The plan developed for discharge from the hospital should be more complete (see Table 3, "Hospital Discharge Checklist for Patients with Asthma Exacerbations" in the original guideline document). A detailed plan for comprehensive long-term management and handling exacerbations should be developed by the asthma care provider at a follow-up visit.

Data are insufficient to support or refute the benefits of using written asthma action plans compared to medical management alone. However a Cochrane review of 25 studies compared self-management interventions by adults with acute asthma episodes. Some had written action plans, others did not. The self-management interventions with

written action plans had the greatest benefits, including reduced emergency department visits and hospitalizations and improved lung function.

The NAEPP EPR-2 recommendations continue that the use of written action plans as part of an overall effort to educate patients in self-management is beneficial especially for patients with moderate or severe persistent asthma and patients with a history of severe exacerbations.

See Annotation Appendix B for Sample Action Plan in the original guideline document.

C. Education

Asthma Education in the ER is the responsibility of the primary asthma caregiver. This may be the ER physician, nurse, or other trained asthma educator.

The patient's readiness to learn and any potential barriers to learning should be identified and addressed.

Patient education is essential for successful management of asthma. It should begin at the time of diagnosis and be ongoing. The following patient education is recommended:

Basic facts about asthma

- The contrast between asthmatic and normal airways
- What happens to the airways in an asthma attack
- How medications work and need for adherence

  Long-term control: medications that prevent symptoms, often by reducing inflammation

  Quick relief: short-acting bronchodilator relaxes muscles around airways

- Stress the importance of long-term control medications and not to expect quick relief from them

Inhaler technique

- Metered dose inhaler (MDI) or nebulizer use (patient should repeat demonstration)
- Spacer/holding chamber use
- Dry powder inhaler (DPI) use

Written action plan including home peak flow monitoring - see Example of Action Plan In Appendix B of the original guideline document

When and how to take actions:

- Monitor symptoms and recognize early signs of deterioration.
- Respond to changes in asthma severity. A written Asthma Action Plan including daily medications and instructions should be offered to all patients with asthma.
- Review and refine the plan at follow-up visits.
- Home peak flow monitoring is recommended for patients with moderate to severe persistent asthma, or anyone with a history of severe exacerbations.
- Discuss plan for children at school including management of exercise-induced bronchospasm.
- Assess adherence to pharmacotherapy and environmental control measures.

Environmental control measures

- Identify and avoid exposure to allergens or other environmental triggers

Emphasize need for regular follow-up visits and asthma treatment adherence

Supervised self-management (using patient education and adjustments of anti-inflammatory medication based on PEF or symptoms coupled with regular medical review utilization and adherence to medication) reduces asthma morbidity and mortality. This reduction includes lost work days, unscheduled office visits, and ER and hospital admissions.

D. Follow-up

Regularly scheduled follow-up visits are essential to ensure that control is maintained and the appropriate step down in therapy is considered.

It is recommended that follow-up with an asthma care provider occur within one week of discharge.

11. Treatment for Incomplete Response

Key Points:

- Systemic (intravenous [IV], oral [PO]) corticosteroids should be used for all patients who do not favorably respond to the initial beta-agonist therapy
- Anticholinergic therapy may increase lung function and may decrease hospital admission rate

See Table 3 in the original guideline document for dosages of medications.

Corticosteroids

Parenteral and enteral administration of corticosteroids requires about 6-24 hours to be effective. IV and oral routes of corticosteroid administration appear to be equivalent. Medium to high doses of corticosteroids appear to be better than low doses, however there is still a large range, roughly 160mg Methylprednisolone per day or 2 mg/kg/day in children. There is no evidence to support very high doses of steroids. The National Asthma Education and Prevention Program guidelines recommend that patients admitted to the hospital should receive IV or PO steroids. There may be a role for inhaled corticosteroids in the emergency department in addition to the IV or PO route; however, the data do not support this as standard of care at this time.

Evidence supporting this recommendation is of classes: A, M

Anticholinergics

Ipratropium bromide or other anticholinergics may be used as an additional bronchodilator in conjunction with a $beta_2$-agonist in cases of acute moderate to severe asthma. It's most beneficial effects appear to be in multiple doses in more severe exacerbations. Literature has been inconsistent, but indicates that anticholinergic therapy may increase FEV_1 or PEF, may decrease hospital admission rates slightly, may decrease the amount of beta-agonist needed, and may prolong bronchodilator effect. These findings were not always statistically significant, and some studies found no benefits. There were no significant adverse reactions, however. In view of this, it is recommended to consider anticholinergic use in moderate to severe asthma exacerbations.

[Conclusion Grade II: See Conclusion Grading Worksheet - Appendix A - Annotation #11 (Anticholinergic Therapy in the original guideline document)]

Evidence supporting this recommendation is of classes: A, M

12. Treatment for Poor Response

Key Points:

- Levalbuterol use in the emergency room may decrease hospital admissions
- Early prevention with BiPAP® may prevent mechanical intubations
- Heliox may be a secondary therapy in asthma patients who do not respond to first-line therapies
- Ketamine should be considered for use only in severe asthma exacerbations
- The decision when to discharge from the ER or admit to the hospital must be individualized and depends on response to treatment, pulmonary function, and socioeconomic factors
- Magnesium sulfate may be beneficial in the treatment of acute asthma
- Reassess patients shortly after inpatient admission

Albuterol / Levalbuterol Comparison

Levalbuterol use in the emergency room may decrease hospital admissions compared with racemic albuterol. Evidence is limited and further study is required before a definite conclusion can be reached. Prehospital use of levalbuterol does not seem to offer any therapeutic advantage over racemic albuterol. Levalbuterol use in the prehospital setting, emergency room and hospital is not associated with any significant adverse events. In hospitalized patients levalbuterol use may decrease length of admission, but evidence is limited.

[Conclusion Grade III: See Conclusion Grading Worksheet - Appendix B - Annotation #12 (Levalbuterol in the original guideline document)]

Evidence supporting this recommendation of classes: A, C

Intermittent Nebulization Versus Continuous Nebulization

Intermittent nebulization versus continuous nebulization in the treatment of acute asthma has been evaluated quite extensively. The data would suggest that these treatments are equally efficacious; however, there may be a trend toward improvement in patients with severe asthma. In a subgroup analysis of patients whose initial FEV_1 was < 50% predicted; there was a statistically significant improvement in FEV_1 in patients treated with continuous nebulization versus intermittent nebulization. Similarly, in another subgroup analysis of patients whose initial PEF was < 200, there was a statistically significant improvement in PEF and a decrease in hospital admissions in patients treated with continuous versus intermittent nebulization. However, in another subgroup of patients whose FEV_1 was <50% predicted, there was no difference in improvement in FEV_1 or hospital admissions in patients treated with continuous versus intermittent nebulization.

A recent meta-analysis suggests equivalence of continuous versus intermittent albuterol in treating asthma. This is measured by pulmonary function testing and rate of admission to the hospital. There does not seem to be any advantage of higher doses of albuterol for continuous nebulization. There was no difference in lung function in patients treated with 7.5 mg or 15 mg. of albuterol. Utilizing albuterol and ipratropium bromide continuously versus albuterol alone, demonstrated a trend toward improvement in reducing the length of stay in the Emergency Department and in hospital admission rates.

Evidence supporting this recommendation of classes: A, M

Bi-level Positive Sir Pressure BiPAP®

BiPAP therapy should be considered for patients presenting with an acute asthma exacerbation. Accumulating studies have shown a benefit in using BiPAP for patients presenting with noncardiogenic respiratory failure. These studies included, but were not limited to, patients with asthma exacerbations.

A recent study compared BiPAP ventilation plus conventional therapy vs. conventional therapy in patients presenting with an acute asthma

exacerbation. Patients in the BiPAP group showed a statistically significant improvement in lung function (measured by FEV_1), improved faster, and were less likely to require admission to the hospital and mechanical intubations.

Evidence supporting this recommendation is of class: A

Heliox

Heliox, a blend of helium and oxygen, is a low-density gas that has been shown in some studies to improve deposition of albuterol into distal airways when compared with nebulized albuterol with oxygen alone. To date, only small-sized randomized controlled trials have been performed. At best, these studies showed mild improvement in spirometry measures and perceived dyspnea scores in patients receiving heliox-driven albuterol nebs versus patients receiving albuterol nebs with oxygen alone. These improved measures were more prominent in patients with moderate to severe asthma exacerbations.

There is not enough evidence from large, prospective, randomized controlled trials to recommend heliox as first-line therapy in patients with asthma exacerbations. However, it is recommended that heliox be considered as a secondary therapy in patients with a severe asthma exacerbation who are not responding to first-line therapies.

Evidence supporting this recommendation is of classes: M, X

Ketamine

Ketamine and propofol are anesthetic agents with neuro-regulatory properties resulting in bronchodilation. The use of ketamine has shown benefit in improving airway parameters, but increased side effects have resulted in longer hospitalizations. Increased side effects of increased secretions, dysphorea and hallucinations are noted. Clinical data suggests that in the nonintubated patient the side effects may cancel benefit. Some reported case reports suggest benefit in intubated patients. Well controlled studies are required to make a clear strong recommendation for use. Use of ketamine has been pursued only in severe asthmatic exacerbations.

Evidence supporting this recommendation is of classes: D, M

Magnesium Sulfate

In vitro, magnesium acts as a smooth muscle dilator and may have some anti-inflammatory effects by decreasing super-oxide production in neutrophils. Its efficacy has not been consistently demonstrated in randomized control trials. It has not been demonstrated to cause any harmful effects. In a recent multicenter trial, IV magnesium sulfate improved pulmonary function only in patients with severe asthma, (FEV_1 < 25%). It did not shorten length of hospital stay. In a systematic review, magnesium sulfate did not demonstrate improvement in PEF, or in hospital length of stay. However, in a subset of patients with severe asthma exacerbations, PEF, FEV_1

and length of stay was improved. There is insufficient evidence to support the routine use of IV magnesium in the emergency room setting. However since it is safe and inexpensive, it should be considered for use in patients with severe asthma exacerbations.

Evidence supporting this recommendation is of classes: A, R

Leukotrienes

The evaluation of leukotrienes for acute asthma care is in its infancy. Pulmonary function has been shown to improve more rapidly when a leukotriene is added to the standard therapy of asthma care (beta-agonists/corticosteroids) in emergency room settings. More studies are needed to confirm these reports.

Montelukast in acute asthma management has been shown to improve pulmonary function in randomized controlled trials. However, statistical significance could not always be maintained.

The evidence is too preliminary to recommend leukotriene modifiers in acute asthma exacerbations.

Evidence supporting this recommendation is of classes: A, R

Consider Hospitalization

The decision when to discharge from the ER or admit to the hospital must be individualized and depends on response to treatment, pulmonary function, and socioeconomic factors. It is important to consider risk factors for asthma-related death. Actual length of stay in the ER will vary; some departments have the ability for more extended treatment and observation, provided there is sufficient monitoring and nursing care.

Response to initial treatment in the ER can be based on a repeat assessment approximately 60-90 minutes after initiating bronchodilator therapy, which is a better predictor of the need for hospitalization than is the severity of an exacerbation on presentation. Evaluation includes the patient's subjective response, physical findings, O_2 saturation, and measurement of airflow. Other aspects to consider include duration and severity of symptoms, course and severity of prior exacerbations, medications used at the time of the exacerbation, access to medical care and medications, adequacy of support and home conditions, and presence of psychiatric illness. Pretreatment O_2 saturation less than 90%, persisting respiratory acidosis, or severe obstruction that does not improve with the administration of sympathomimetics indicates the need for hospitalization.

Discharge is appropriate if FEV_1 or PEF has returned to greater than or equal to 80% personal best or predicted, and symptoms are minimal or absent. Patients with an incomplete response (FEV_1 or PEF 50-80%), and with mild symptoms should be assessed individually and may be appropriate for discharge with consideration of the above factors. It is recommended that

patients with a rapid good response be observed for 30-60 minutes after the most recent dose of bronchodilator to ensure stability of response before being discharged home.

Evidence supporting this recommendation is of classes: C, M, R

Refer to the original guideline document for dosages of drugs for asthma exacerbations.

Special Populations

Asthma in Pregnancy

The goals of asthma management in pregnancy include reducing medication toxicity, teratogenicity and preserving uteroplacental circulation. Changes in the mother's asthma status are expected in almost half of patients with half of these expecting a worsening of asthma status, particularly if previous pregnancies had similar outcomes. Typical changes of pregnancy - those of increased heart rate, respiratory rate and decreases in baseline CO_2 levels, can lead to under-diagnosing asthma severity if not recognized.

The treatment of acute asthma in pregnancy follows the guidelines for acute asthma care keeping in mind the goals of the management and changes in physiology.

Beta-agonists have not been linked to adverse fetal outcomes in follow-up studies. Systemic steroids, if used in the first trimester, may, though rarely, increase the frequency of cleft palate, and possibly be associated with development of pre-eclampsia. However, the risk to both mother and fetus of an unmanaged severe asthmatic attack overshadows the medication observed risks.

Evidence supporting this recommendation is of class: R

Hospital Management Algorithm Annotations

17. Assessment/History and Physical

Patients being admitted from the ER with an acute asthma exacerbation should be reassessed shortly after admission, with special emphasis on whether the patient is showing any clinical signs of improvement or deterioration (See Annotation #2 "Assess Severity of Asthma Exacerbation"). Objective data should include repeating of the patient's FEV_1 or PEF. A complete physical exam should include emphasis on the patient's respiratory rate, air entry on lung exam, and the presence/absence of signs of increased work of breathing, such as supraclavicular or intercostal retractions.

24. Continue Treatment

Consider other illnesses and comorbidities. These may also cause dyspnea, chest tightness and wheezing.

- Pneumothorax
- Pulmonary embolism
- Vocal cord dysfunction syndrome
- COPD
- Pulmonary edema
- Endobronchial obstruction (tumor or foreign body)
- Bronchiolitis
- Acute hypersensitivity pneumonitis
- Epiglottis

Definitions:

Conclusion Grades:

Grade I: The evidence consists of results from studies of strong design for answering the question addressed. The results are both clinically important and consistent with minor exceptions at most. The results are free of any significant doubts about generalizability, bias, and flaws in research design. Studies with negative results have sufficiently large samples to have adequate statistical power.

Grade II: The evidence consists of results from studies of strong design for answering the question addressed, but there is some uncertainty attached to the conclusion because of inconsistencies among the results from the studies or because of minor doubts about generalizability, bias, research design flaws, or adequacy of sample size. Alternatively, the evidence consists solely of results from weaker designs for the question addressed, but the results have been confirmed in separate studies and are consistent with minor exceptions at most.

Grade III: The evidence consists of results from studies of strong design for answering the question addressed, but there is substantial uncertainty attached to the conclusion because of inconsistencies among the results of different studies or because of serious doubts about generalizability, bias, research design flaws, or adequacy of sample size. Alternatively, the evidence consists solely of results from a limited number of studies of weak design for answering the question addressed.

Grade Not Assignable: There is no evidence available that directly supports or refutes the conclusion.

Classes of Research Reports:

A. Primary Reports of New Data Collection:

Class A:

- Randomized, controlled trial

Class B:

- Cohort study

Class C:

- Nonrandomized trial with concurrent or historical controls
- Case-control study
- Study of sensitivity and specificity of a diagnostic test
- Population-based descriptive study

Class D:

- Cross-sectional study
- Case series
- Case report

B. Reports that Synthesize or Reflect upon Collections of Primary Reports:

Class M:

- Meta-analysis
- Systematic review
- Decision analysis
- Cost-effectiveness analysis

Class R:

- Consensus statement
- Consensus report
- Narrative review

Class X:

- Medical opinion

CLINICAL ALGORITHM(S)

Detailed and annotated algorithms are provided for:

- Emergency Room Management of Asthma
- Inpatient Management of Asthma

EVIDENCE SUPPORTING THE RECOMMENDATIONS

TYPE OF EVIDENCE SUPPORTING THE RECOMMENDATIONS

The guideline contains an annotated bibliography and discussion of the evidence supporting each recommendation. The type of supporting evidence is classified for selected recommendations (see "Major Recommendations").

In addition, key conclusions contained in the Work Group's algorithm are supported by a grading worksheet that summarizes the important studies pertaining to the conclusion. The type and quality of the evidence supporting

these key recommendations (i.e., choice among alternative therapeutic approaches) is graded for each study.

BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS

POTENTIAL BENEFITS

- Improved assessment of patient presenting with asthma exacerbations
- Improved treatment and management of inpatient asthma
- Improved lung function
- Decreased hospital admission rates
- Decreased length of stay in Emergency Rooms

POTENTIAL HARMS

Adverse Effects of Medications

- The Food and Drug Administration has reported that salmeterol may be associated with an increased risk of death from asthma.
- The use of ketamine has shown increased side effects resulting in longer hospitalization. Increased secretions, dysphorea, and hallucinations are noted. Clinical data suggests that in the nonintubated patient the side effects may cancel benefit.
- Systemic steroids used in the first trimester of pregnancy may rarely increase the incidence of cleft palate, and possibly be associated with development of pre-eclampsia. However, the risk to both mother and fetus of an unmanaged severe asthmatic attack overshadows the medication observed risks.

QUALIFYING STATEMENTS

QUALIFYING STATEMENTS

- These clinical guidelines are designed to assist-clinicians by providing an analytical framework for the evaluation and treatment of patients, and are not intended either to replace a clinician's judgment or to establish a protocol for all patients with a particular condition. A guideline will rarely establish the only approach to a problem.
- This medical guideline should not be construed as medical advice or medical opinion related to any specific facts or circumstances. Patients are urged to consult a health care professional regarding their own situation and any specific medical questions they may have.

IMPLEMENTATION OF THE GUIDELINE

DESCRIPTION OF IMPLEMENTATION STRATEGY

Once a guideline is approved for general implementation, a medical group can choose to concentrate on the implementation of that guideline. When four or more groups choose the same guideline to implement and they wish to collaborate with others, they may form an action group.

In the action group, each medical group sets specific goals they plan to achieve in improving patient care based on the particular guideline(s). Each medical group shares its experiences and supporting measurement results within the action group. This sharing facilitates a collaborative learning environment. Action group learnings are also documented and shared with interested medical groups within the collaborative.

Currently, action groups may focus on one guideline or a set of guidelines such as hypertension, lipid treatment, and tobacco cessation.

Priority Aims and Suggested Measures

1. Improve the timely and accurate assessment of patients presenting with an asthma exacerbation.

   Possible measures of accomplishing this aim:

   a. Percentage of patients with diagnosed asthma who have documentation of peak flow measurement during the initial assessment in Emergency Room (ER) or hospital.
   b. Percentage of patients with asthma with any assessment of asthma severity documented during the initial assessment in ER or hospital. (Annotation #2)
   c. Percentage of patients with diagnosed asthma who receive appropriate treatment as rapidly as possible based on response. (Good, Incomplete, or Poor response, Annotations #6-12)

2. Improve the treatment and management of inpatient asthma.

   Possible measures of accomplishing this aim:

   a. Percentage of inpatients with diagnosed asthma for which the admission order set is used.
   b. Percentage of inpatients with diagnosed asthma who are discharged on an inhaled anti-inflammatory medication.
   c. Percentage of patients with asthma with an asthma action plan in the medical record.
   d. Percentage of inpatients with diagnosed asthma who are readmitted to hospital (hospital admission rate) within 30 days.
   e. Percentage of patients with diagnosed asthma who return to the ER for treatment of asthma within 30 days of last visit.
   f. Percentage of inpatients or ER asthma patients who have an appointment with asthma health care provider within one week of discharge.

At this point in development for this guideline, there are no specifications written for possible measures listed above. ICSI will seek input from the medical groups on what measures are of most use as they implement the guideline. In a future revision of the guideline, measurement specifications may be included.

IMPLEMENTATION TOOLS

Clinical Algorithm
Pocket Guide/Reference Cards

For information about availability, see the "Availability of Companion Documents" and "Patient Resources" fields below.

INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES

IOM CARE NEED

Getting Better
Living with Illness

IOM DOMAIN

Effectiveness
Patient-centeredness
Timeliness

IDENTIFYING INFORMATION AND AVAILABILITY

BIBLIOGRAPHIC SOURCE(S)

Institute for Clinical Systems Improvement (ICSI). Emergency and inpatient management of asthma. Bloomington (MN): Institute for Clinical Systems Improvement (ICSI); 2004 Dec. 38 p. [53 references]

ADAPTATION

Not applicable: The guideline was not adapted from another source.

DATE RELEASED

2004 Dec

GUIDELINE DEVELOPER(S)

Institute for Clinical Systems Improvement - Private Nonprofit Organization

GUIDELINE DEVELOPER COMMENT

Organizations participating in the Institute for Clinical Systems Improvement (ICSI): Affiliated Community Medical Centers, Allina Medical Clinic, Altru Health System, Aspen Medical Group, Avera Health, CentraCare, Columbia Park Medical Group, Community-University Health Care Center, Dakota Clinic, ENT Specialty Care, Fairview Health Services, Family HealthServices Minnesota, Family Practice Medical Center, Gateway Family Health Clinic, Gillette Children's Specialty Healthcare, Grand Itasca Clinic and Hospital, HealthEast Care System, HealthPartners Central Minnesota Clinics, HealthPartners Medical Group and

Clinics, Hutchinson Area Health Care, Hutchinson Medical Center, Lakeview Clinic, Mayo Clinic, Mercy Hospital and Health Care Center, MeritCare, Mille Lacs Health System, Minnesota Gastroenterology, Montevideo Clinic, North Clinic, North Memorial Care System, North Suburban Family Physicians, Northwest Family Physicians, Olmsted Medical Center, Park Nicollet Health Services, Pilot City Health Center, Quello Clinic, Ridgeview Medical Center, River Falls Medical Clinic, Saint Mary's/Duluth Clinic Health System, St. Paul Heart Clinic, Sioux Valley Hospitals and Health System, Southside Community Health Services, Stillwater Medical Group, SuperiorHealth Medical Group, University of Minnesota Physicians, Winona Clinic, Ltd., Winona Health

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GUIDELINE COMMITTEE

Respiratory Steering Committee

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FINANCIAL DISCLOSURES/CONFLICTS OF INTEREST

In the interest of full disclosure, ICSI has adopted the policy of revealing relationships work group members have with companies that sell products or services that are relevant to this guideline topic. The reader should not assume that these financial interests will have an adverse impact on the content of the

guideline. Readers of the guideline may assume that only work group members listed below have potential conflicts of interest to disclose.

Richard Sveum received grant support from Merck, Aventis, Glaxo.

David Lowe received honoraria from Glaxo Smith Kline.

No other work group members have potential conflicts of interest to disclose.

ICSI's conflict of interest policy and procedures are available for review on ICSI's website at www.icsi.org.

GUIDELINE STATUS

This is the current release of the guideline.

GUIDELINE AVAILABILITY

Electronic copies: Available from the Institute for Clinical Systems Improvement (ICSI) Web site.

Print copies: Available from ICSI, 8009 34th Avenue South, Suite 1200, Bloomington, MN 55425; telephone, (952) 814-7060; fax, (952) 858-9675; Web site: www.icsi.org; e-mail: icsi.info@icsi.org.

AVAILABILITY OF COMPANION DOCUMENTS

The following is available:

- ICSI pocket guidelines. April 2004 edition. Bloomington (MN): Institute for Clinical Systems Improvement, 2004. 404 p.

Print copies: Available from ICSI, 8009 34th Avenue South, Suite 1200, Bloomington, MN 55425; telephone, (952) 814-7060; fax, (952) 858-9675; Web site: www.icsi.org; e-mail: icsi.info@icsi.org.

PATIENT RESOURCES

None available

NGC STATUS

This NGC summary was completed by ECRI on February 15, 2005.

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